WHAT IS CLAIMED IS:

1. A hydrocyclone for effecting separation of a combined phase input stream with at least two constituents comprising:

inner and outer spaced shells which are concentric with a longitudinal axis and each of which has an inner surface and an outer surface, the outer shell having an inner surface radius with respect to said longitudinal axis which is greater than the radius of the outer surface of the inner shell with respect to said axis to form therebetween a cyclone chamber providing a helical path for the stream, the shells having an input opening therebetween at one end of the cyclone chamber for receiving the stream and an output opening therebetween at the opposite end of the cyclone chamber for discharging separated constituents of the stream;

wherein the inner surface of the inner shell is spaced from the longitudinal axis and defines an inner shell bore which has one end at and which extends from the chamber output opening to adjacent the chamber input opening for conveying a separated constituent to an end of the bore adjacent the chamber input opening;

at least one wall forming an expansion chamber which is within a circle lying in a plane perpendicular to and centered on the longitudinal axis and having a radius not more than 30% greater than the radius of the outer surface of the outer shell, said expansion chamber having a first opening which opens to the input opening of the cyclone chamber and a second opening spaced from the first opening for providing the input stream to the expansion chamber, the spacing of the first opening and the second opening and the dimensions of the expansion chamber being selected to substantially reduce the velocity of the input stream, at least by the time that the stream reaches the input opening of the cyclone chamber, with respect to the velocity of the input stream at the second opening of the expansion chamber; and

a tubular extension of the inner shell extending from the end of the bore of the inner shell adjacent the input opening of the cyclone chamber to exteriorly of the expansion chamber.

2. The hydrocyclone of claim 1 wherein the second opening of the expansion chamber is laterally offset with respect to the longitudinal axis.

3. The hydrocyclone of claim 2 wherein the second opening opens in the

direction substantially parallel to the longitudinal axis.

4. The hydrocyclone of claim 2 wherein the second opening of the expansion chamber is an opening in the outer shell and opens transversely to the longitudinal axis.

5. The hydrocyclone of claim 2 wherein said tubular extension of the inner shell has an outlet opening exteriorly of the expansion chamber which is laterally offset from said axis and which opens in the direction parallel to the longitudinal axis.

6. The hydrocyclone of claim 1 wherein said tubular extension passes through the expansion chamber and the portion of the tubular extension exterior to the expansion chamber is laterally offset from said axis.

7. The hydrocyclone of claim 1 wherein all cross-sections of the hydrocyclone perpendicular to said axis are not substantially larger than a circle centered on said axis and in a plane perpendicular to the longitudinal axis and having a radius substantially equal to the radius of the outer surface of the outer shell.

8. The hydrocyclone of claim 1 wherein the overall length of the hydrocyclone in the direction of said axis and the circumferential dimensions of the hydrocyclone are selected so that the hydrocyclone can traverse a bend in a pipe of five inches interior diameter and having a bend radius of forty feet.

9. The hydrocyclone of claim 1 wherein the expansion chamber reduces the velocity of the input stream at the input opening of the cyclone chamber to about one-half of the velocity of the input stream at the second opening.

10. The hydrocyclone of claim 1 wherein the tubular extension passes through the expansion chamber.

11. The hydrocyclone of claim 1 wherein the radial spacing between the inner and outer shells is small relative to the radius of the inner surface of the outer shell.

12. The hydrocyclone of claim 11 wherein the radial spacing between the inner and outer shells is less than about one-half of the radius of the inner surface of the outer shell.

13. A hydrocyclone for effecting separation of a combined phase input stream with at least two constituents comprising:

inner and outer spaced shells which are concentric with a longitudinal axis, the outer shell having a radius with respect to said longitudinal axis which is greater than the radius of the inner shell with respect to said axis and the inner and outer shells form therebetween a cyclone chamber providing a helical path for the stream, the shells having an input opening therebetween at one end of the cyclone chamber for receiving the stream and an output opening therebetween

at the opposite end of the cyclone chamber for discharging separated constituents of the stream;

the inner shell having a bore which has one end at the chamber output opening and which extends from the chamber output opening to adjacent the chamber input opening for conveying a separated constituent to an end of the bore adjacent the chamber input opening;

at least one wall forming an expansion chamber with a first opening which opens to the input opening of the cyclone chamber and a second opening which opens in the direction substantially parallel to the longitudinal axis and which is spaced from the first opening for providing the input stream to the expansion chamber, the spacing of the first opening and the second opening and the size of the expansion chamber being selected to substantially reduce the velocity of the input stream at the input opening of the cyclone chamber with respect to the velocity of the input stream at the second opening of the expansion chamber; and

a tubular extension of the inner shell extending from the end of the bore of the inner shell adjacent the input opening of the cyclone to exteriorly of the expansion chamber.

14. The hydrocyclone of claim 13 wherein the second opening of the expansion chamber is laterally offset with respect to the longitudinal axis.

15. The hydrocyclone of claim 14 wherein said tubular extension of the inner shell has an outlet opening exteriorly of the expansion chamber which is laterally offset from said axis and which opens in the direction parallel to the longitudinal axis.

16. The hydrocyclone of claim 13 wherein said tubular extension passes through the expansion chamber and the portion of the tubular extension exterior to the expansion chamber is laterally offset from said axis.

17. The hydrocyclone of claim 13 wherein all cross-sections of the hydrocyclone perpendicular to said axis are not substantially larger than a circle centered on said axis and in a plane perpendicular to the longitudinal axis and having a radius substantially equal to the radius of the outer surface of the outer shell.

18. The hydrocyclone of claim 13 wherein the expansion chamber reduces the velocity of the input stream at the input opening of the cyclone chamber to not more than about one-half of the velocity of the input stream at the second opening.

19. The hydrocyclone of claim 13 wherein the radial spacing between the

inner and outer shells is small relative to the radius of the inner surface of the outer shell.

20. The hydrocyclone of claim 19 wherein the radial spacing between the inner and outer shells is less than about thirty percent of the radius of the inner surface of the outer shell.

21. A hydrocyclone for effecting separation of a combined phase input stream with at least two constituents comprising:

inner and outer spaced shells which are concentric with a longitudinal axis, the outer shell having a radius with respect to said longitudinal axis which is greater than the radius of the inner shell with respect to said axis and the inner and outer shells form therebetween a cyclone chamber providing a helical path for the stream, the shells having an input opening therebetween at one end of the cyclone chamber for receiving the stream and an output opening therebetween at the opposite end of the cyclone chamber for discharging separated constituents of the stream;

the inner shell having a bore which has one end at the chamber output opening and which extends from the chamber output opening to adjacent the chamber input opening for conveying a separated constituent to an end of the bore adjacent the chamber input opening;

an expansion chamber with a first opening which opens to the input opening of the cyclone chamber

and a second opening which opens to exterior of the cyclone chamber and which is spaced from the first opening for providing the input stream to the expansion chamber, the spacing of the first opening and the second opening and the size of the expansion chamber being selected to substantially reduce the velocity of the input stream at the input opening of the cyclone chamber with respect to the velocity of the input stream at the second opening of the expansion chamber; and

a tubular extension of the inner shell extending from the end of the bore of the inner shell adjacent the input opening of the cyclone to exteriorly of the expansion chamber.

22. The hydrocyclone of claim 21 wherein the expansion chamber reduces the velocity of the input stream at the input opening of the cyclone chamber to not more than about one-half of the velocity of the input stream at the second opening.

23. The hydrocyclone of claim 21 wherein the radial spacing between the

inner and outer shells is small relative to the radius of the inner surface of the outer shell.

24. The hydrocyclone of claim 21 wherein the radial spacing between the inner and outer shells is less than about thirty percent of the radius of the inner surface of the outer shell.

25. The hydrocyclone of claim 21 wherein the expansion chamber is located exteriorly of the cyclone chamber.

26. The hydrocyclone of claim 25 wherein the expansion chamber is situated generally along a longitudinal axis perpendicular to the axis of the cyclone chamber.

27. The hydrocyclone of claim 21 wherein a diameter of the expansion chamber at the first opening is approximately equal to at least a diameter of the inner surface of the outer shell.

28. The hydrocyclone of claim 21 wherein the expansion chamber comprises a concentric reducer.

29. The hydrocyclone of claim 21 further comprising a second expansion chamber located between an exit from the helical path and the output opening.